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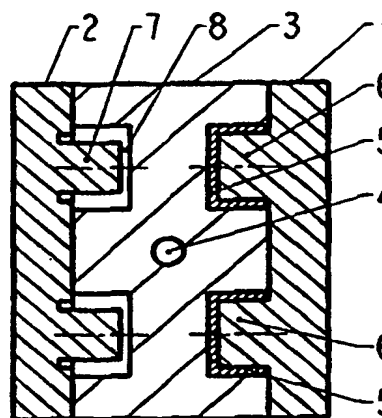
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/DK98/00034 <b>(22) International Filing Date:</b> 28 January 1998 (28.01.98) <b>(30) Priority Data:</b> 0103/97 29 January 1997 (29.01.97) DK <b>(71)(72) Applicant and Inventor:</b> GRAM, Jes, Tougaard [DK/DK]; Bistrupvej 105 A, DK-3460 Birkerød (DK).			<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Danish).</i>

**(54) Title:** PROCEDURE AND MACHINERY FOR THE MOULDING OF AN ASSEMBLED OBJECT

**(57) Abstract**

The invention concerns a procedure for sequential moulding of an assembled object and a machine for the performance of the procedure. The in at least two subsequent mouldings produced object is moulded in a mould with a usually stationary front part (1), a movable back part (2) and at least one turnable middle part (3). After the moulding of the first part of the object (5), the middle part (3) is turned at least once, preferably 180 degrees around an axis/axle (4) placed in a right angle to the moving direction between the front part and the back part, before the moulding of the following part of the object (10) takes place. In this way the first part of the object from the moulding at the front part (1) can be transported via the turnable middle part (3) to the back part (2), where the following moulding on the object can take place. As well as the injection and the cooling can take place in the front part and in the back at the same time, a lot of cycle time can be saved. In a special design the middle part (3) can be equipped with an insulation (11) in the middle which secures that between the front part (1) and the middle part (3) can be maintained a higher temperature than between the middle part and the back part (2). Hereby it is possible to mould together considerably different materials such as a thermo plastic material and an elastomer, a silicone, or metal and plastic.



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Title: Procedure and machinery for the moulding of an assembled object

The invention concerns a procedure for the production of one in at least two subsequent castings moulded object in a mould consisting of at least three mould parts, and a machine for the performance of this procedure.

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It is a known technique to mould an object in two or more subsequent castings, e.g. an injection moulded object in plastic in two different colours casted subsequently. This can be realized by first moulding the material of one colour in one part of the for this purpose arranged mould, e.g. a letter in a key in a keyboard. After the cooling of the material and removal of the core parts of the mold, the material of the other colour is moulded around the moulded letter, which now itself serves as a part of the mould, in the same mould, for the final key. This procedure requires an injection moulding machine with two injection units.

There are also known injection moulds which consists of more than two mould parts, a front part and a back part, e.g. the so-called sandwich moulds which also consist of a movable middle part placed between the two other mould parts. The purpose of such a mould is not to cast objects in two or more subsequent castings, but to cast more objects at the same time in the same mould by using the in this way doubled closing area of the mould.

Among injection moulds containing more than one front part and one back part are further known the so-called three plate tools. Between the front part and the back part is placed a third plate as a mould part. Due to the fact that the inlet channels in the mould are placed between the two foremost mould parts and the objects between the two hindmost you achieve, that the inlet and the objects are being torn off and ejected separately when the mould is opened. The advantage hereby is that the inlet and the finished objects thus can be kept separated more easily.

There are also known moulds which in their front part or their back part has an insertion which can be turned while the mould is open. In the hitherto known cases this insertion exclusively is turned around an axis which is parallel to the mutual direction of movement between the front part and the back part, thus you can achieve the same effect as by a turning table. The purpose of this turning movement is to achieve some extra steps during the moulding cycle, so that there e.g. can be injected material in the mould and simultaneously cooling the mould and thereby saving cycle time.

The purpose of this procedure and machinery according to the invention is that by the casting of multi component objects a highly increased number of objects per time unit in a defined mould are achieved. Also you can use a considerable smaller moulding machine than possible up till now and still achieve the same number of objects per time unit.

The procedure according to the invention is characterized by the fact that at least one middle part placed between the moulds preferably stationary front part and the movable back part after moulding of the first part of the object are turned  
5 at least one time preferably 180 degrees around an axis/axle which preferably is in a right angle to the movement direction between the front part of the mould and the back part, before the moulding of the following part of the object.

10 Due to the fact that the middle part after the moulding of the first part of the object are turned 180 degrees around an axis which is not parallel to, but in a right angle to the movement direction between the front part and the back part, a number of interesting possibilities are achieved, that has not yet  
15 been possible to achieve by the hitherto known designs of moulds.

As explanation of the principle in the procedure a simple example can be chosen where each cycle moulds a single object  
20 comprising two parts where the front and the back of the middle part are identical. The moulding of the first part of the object are made in the cavity formed between the front part and the middle part. After a suitable cooling of the object, the mould is opened so that the middle part can be  
25 turned 180 degrees preferably around a vertical axis. Doing this you must secure that the first moulded part of the object remains positioned on the part of the middle part facing the front part during the moulding.

30 After turning the middle part 180 degrees the mould is closed again, now with the first moulded part facing the back part and forming an integrated part of the mould for the hereby achieved new cavity. Between the middle part and the back part you hereby can perform the following moulding of material from  
35 another moulding unit on the partly moulded object. Suitable simultaneously with this final moulding on the first object there can in the now remade cavity between the front part and the middle part be performed the first moulding on the next object form the first moulding unit.

40 After a suitable cooling and hardening of the objects in both the moulding parts, suitably using the same part of the cycle time, the mould is opened and the first complete moulded object is ejected from the back part. At the same time the  
45 middle part is turned, with the partly moulded next object placed on its other identically surface, again 180 degrees preferably back to, but possibly forwards to, its original position. Hereafter the mould is closed again and there are injected the respective materials from the two injection  
50 units, suitable simultaneously in the two mould cavities between respectively the front part and the middle part, where the first part of the following object is moulded, and between the middle part and the back part where the second and finished object is moulded. Afterwards the described cycle can

be repeated in a current production of finished assembled objects.

5 The above described cycle concerns a single assembled object ejected from the mould each time; but in principle the same will be the case for a larger quantity of cavities per mould part. In the example above it is only necessary with a single turnable middle part because the assembled object only consists of two parts.

10 If the assembled object consists of more parts, the procedure also in principle is the same. Should more stations be needed due to this, an extra turnable middle part or more can be added.

15 It can possibly be of advantage that the turning movement of the middle part is performed outside the space between the front part and the back part. This can be realized through some kind of cassette system where the middle plate in a running cycle can be replaced with a corresponding middle plate and turned between the single mouldings outside the actual moulding area between the front part and the back part.

20 The procedure according to the invention can in this way result in a considerable time- and costreduction by the moulding of assembled objects in relation to the hitherto known procedures of moulding in sequence two or more assembled objects.

25 If the objects to be moulded not as foreseen in the above described example are suitably symmetrical, you can achieve the same effect due to the front and the back of the turnable middle part of the mould are each others reflection. The two surfaces of the middle part can also possibly correspond in another way.

30 By the designing of the moulding equipment it as mentioned must be considered, that the object or set of objects at the opening of the mould after the first moulding are released from the stationary mould part and remains positioned in/on the turnable middle part and thereby being removed to the space between the middle part and the other mould part. This removal can simplest be achieved by a better hold-down in the middle part than in the front part and respectively a better hold-down in the back part than in the middle part.

35 The necessary removal of the object from the front part, where the first part of the material is injected, via the middle part to the back part where the final portion of the material is injected, as well as where the ejection of the finished assembled object takes place, can also be achieved in another way. This e.g. can be realized by an ejector-, core pull- or jaw system placed in the turnable middle part. The ejector system e.g. can be of a new design especially developed for

the middle part where the ejectors has a direct connection between the opposing cavities in the middle part. Hereby the ejectors e.g. through a ball screw system placed in the middle of the ejector in the middle plate can move the ejectors forth  
5 and backwards in the part of the middle plate facing the back part. While the ejectors have a direct connection between the opposing cavities or cores in the middle plate it hereby becomes possible to eject the objects, there are positioned on a core or in another way are placed on the middle part,  
10 without using any considerable space in the mould for this purpose.

In a special design of the machinery for the performance of the procedure according to the invention, at least one of the  
15 turnable middle parts are thermally insulated e. g. with an insulating plate between the front and the back of the middle part. It can hereby be achieved, that e.g. in the cavities between the front part and the middle part, a considerably higher temperature can be sustained, than in the cavities  
20 between the middle part and the back part. This in principle can also be realized by the traditional index mould/turn mould where e.g. the one part of the movable plate is insulated opposed to the other part.

25 For the best possible utilization of the insulated middle part the following minor changes of the above-mentioned procedure can be recommended: When the partly moulded object or objects are removed from the hot area between the front part and the middle part to the cooler area between the movable middle part  
30 and the back part, the middle part is turned immediate after the object/objects hereby has been transferred to be positioned in the back part, and 180 degrees backwards again. Hereby the hottest part of the middle plate will always be pushed against the hot front part, whereby it e.g. becomes  
35 easier to sustain a considerably higher temperature in the area at the front part than in the area at the back part.

The advantage in sustaining a constant and high difference in temperature in the mentioned areas is that you hereby achieve  
40 the possibility to mould two different materials together, which normally is not possible by the use of a traditional mould. It can e.g. be a thermo plastic material and an elastomer, a thermo plastic material and a silicone plastic, a silicone and a metal and so forth.

45 This method to sustain a considerable difference in temperature between two areas in the mould on the contrary will hardly be necessary when using the procedure according to the invention to mould a thermo plastic material together with  
50 a metal or two different metals together. This because both metals and thermo plastic materials are ejected in cooled conditions.

Using the procedure according to the invention you e.g. can mould a metal as aluminium in the front part and a polyolefine in the back part. Hereby there also can be obtained the advantage that when the plastic is moulded around the metal, the plastic material can cover the rough edges that appear by the moulding of metals. These rough edges that normally appear when moulding metal, therefore need not be removed, but on the contrary they can contribute with a better connection of the plastic to the metal. This give possibilities to develop a machine according to the invention that is capable of moulding plastic and metal together. But such a combined plastic and metal moulding machine can also be utilized in connection with existing mould constructions.

15 The more precise advantages and designs of the invention will appear from the drawing and the connected description.

Fig. 1 shows a design with a closed mould and the first part of the object moulded

20 Fig. 2 shows the same during opening

Fig. 3 shows the same in fully opened condition with the middle part turned 90 degrees

25 Fig. 4 shows the same during closing

Fig. 5 shows the same fully closed

30 Fig. 6 shows the same after the moulding in both sides of the middle part

Fig. 7 shows the same after opening and ejection of the first finished object

35 Fig. 8 shows a design with an insulation in the middle part

Fig. 9 shows a design with the middle part operating in sections.

40 In fig. 1 is shown from above a section of an example of a closed mould to perform the procedure according to the invention. The mould consists of a stationary front part 1 and a movable back part 2, as well as a movable middle part 3, that further can be turned around an in this case vertical placed axis/axle 4. In the shown example is just moulded as the first part 5 of the object a screw cap intended to be moulded separably together with a matching threaded tube neck for serving as a closure on a glass for pills. On the front part 1 is also a not shown injection unit. On the front part is shown the threaded cores 6 and on the back part 2 are shown the cores 7, which are smaller than the threaded cores 6, to allow the following moulding of the threaded tube neck, which here is the last moulded part of the assembled object. In the

middle part 3 is shown the in both ends identically designed cavities/mould cavities 8.

Fig. 2 shows the same mould during opening, where the back  
5 part 2 is moving left with the double speed of the middle part 3, which carries the first moulded parts of the object 5 positioned in the cavities 8.

In fig. 3 is shown the same mould fully opened, where the  
10 middle part 3 now is performing its turning and is turned 90 degrees which means half-way around its axis/axle 4.

On fig. 4 is seen the same mould in the process of closing, and  
15 where the middle part 3 has fulfilled its turning of 180 degrees, so that the first moulded parts 5 of the object now face the back part.

Fig. 5 shows the mould in closed condition where the first  
20 moulded parts 5 of the object, here the cooled screw cap, are ready to perform as a part of the mould, as they in connection with the cores 7 in the back part 2, which has a smaller diameter than the cores 6 in the front part 1, forms cavities 9.

In fig. 6 are shown the same mould also in closed condition  
25 where the second part of the assembled object 10, the threaded tube neck, now are moulded in mould cavities 9 in the back part 2. Simultaneously the first parts of the next set of assembled objects are being moulded in the front part 1. The injection in the two surfaces of the middle part 3, as well as  
30 the cooling, has occurred at the same time, saving a considerable amount of cycle time.

In fig. 7 are seen the finishing of the first cycle, where the  
35 mould is opened and the cooled, assembled object (5, 10) now is being ejected from the back part 2 by means of ejectors not shown on the figure. As the last moulded parts of the objects 10, here the threaded tube necks, is moulded innermost, they have shrunk a little bit compared to the screw caps, whereby the two parts afterwards easily can be separated  
40 and reassembled manually. In the right part of the middle part 3 the first parts of the next portion of objects are passing from the front part 1, after a turning of 180 degrees, to be placed in the back part 2, so that the following cycle is continued and the process can proceed.

45 In fig. 8 is shown a special design of the turnable middle part 3 supplied in the middle with an insulating plate 11 or similar, which can cause, that in the area of the mould at the front part 1 a higher temperature can be maintained, than in  
50 the area at the back part 2. This is achieved especially when the turnable middle part 3, having delivered a set of the first moulded part of the object to the back part 2, immediately are turned back again.



- Fig. 9 shows a special design of the turnable middle part 3 where it for practical reasons is separated in two or more slim, preferably identically and vertically placed sections. Here is only shown two sections (3', 3'') each able to turn around a vertical axis/axle (4', 4''). The lesser maximum turning radius of each of the slim sections causes that the necessary distance between the front part 1 and the back part 2 at the opening will be considerably reduced. A considerably larger distance between the front part and the back part would be necessary if a single middle part 3, with the same number of cavities and width equal to the sum of the width of the single sections, should be able to turn 180 degrees in the space between the front part 1 and the back part 2.
- 15 The on the drawing shown designs of the machine according to the invention are only a part of the possible examples. Yet they should be able to show the fundamental principles of the invention.
- 20 Besides the shown there also could have been displayed the special ejectors in the middle part 3, that connects the connecting cavities or cores on the two opposite surfaces of the middle part. Using a ball screw or another mechanism in the middle of the ejectors, they can be moved forth and backwards, and thus utilized for ejecting the assembled objects if the objects after the last moulding are to be ejected from the middle part 3.

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## Claims

1. Procedure for the production of one in at least two subsequent castings moulded object in a mould consisting of at least three mould parts, characterized by the fact that at least one middle part (3), placed between the preferably stationary front part (1) and the movable back part (2), after moulding of the first part of the object (5) are turned at least one time preferably 180 degrees around an axis/axle (4), which preferably is in a right angle to the movement direction between the front part (1) of the mould and the back part (2), before the moulding of the following part of the object (10).
2. Procedure for the production of one in at least two subsequent castings moulded object as mentioned in claim 1, characterized by the fact that the material in the at least two moulded parts of the object (5) and (10) either can be the same, e.g. the same thermo plastic material, or different materials such as two different thermo plastic materials, a thermo plastic material and an elastomer or a thermo plastic material and one for the sinter process decided material.
3. Procedure for the production of one in at least two subsequent castings moulded object as mentioned in one or more of the previous claims, characterized by the fact that at least one of the turnable middle parts (3) is thermal insulated, e.g. with an insulating plate (11) between the two surfaces of the middle part (3), so that e.g. in the area of the mould on one side of the middle part (3) by the front part (1) a clearly higher temperature can be maintained than in the area at the back part (2). (This method can also be realized with a normal index mould/turn mould, where the one side of the turnable part is insulated in respect to the other side, as well as a combination of the two designs is possible).
4. Procedure as mentioned in claim 3, characterized by the fact that the with the insulating plate (11) equipped turnable middle part (3) are turned 180 degrees before the object/objects are removed from the first part of the mould to the second part of the mould, hereafter the middle part (3) is turned back again, whereby the objects e.g. can be transferred from a warm to a colder mould part without these two mould parts being in considerable contact with each other, while the object/objects are transferred to the new temperature area. Hereafter the middle part is turned 180 degrees again and the moulding continues. Using this procedure two considerable different materials e.g. can be moulded together, such as a thermo plastic material and an elastomer, silicone etc.. (This method can also be realized by a normal index mould/turn mould).
5. Procedure/machine for the production of one in at least two subsequent castings moulded object as mentioned in one or more of the previous claims, characterized by the fact that the

front of the turnable middle part(s) (3) preferably are identical with the back, are a reflexion hereof or that front and the opposite surface corresponds to each other in another way.

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6. Procedure/machine for the production of one in at least two subsequent castings moulded object as mentioned in one or more of the previous claims, characterized by the fact that if the middle part (3) contains objects to be removed, the ejectors  
10 in the middle part (3) can be designed as a direct connection between the to each other corresponding cavities and/or cores on respectively the front side and the back side of the middle part, and at the same time being provided with a special designed ball screw or a corresponding mechanism, which can  
15 cause the ejectors to serve their purpose and can be moved in both directions, as it has no influence on the moulding process that the ejector is moving away from the corresponding object. Consequently there will be no need for the relatively large space vertically, which is necessary by the normal  
20 ejector systems with ejector plate or similar mechanisms.

7. Procedure/machine for the production of one in at least two subsequent castings moulded object as mentioned in one or more of the previous claims, characterized by the fact that the  
25 hold-down, that keeps the object in the mould at a following moulding, is stronger than the hold-down of the previous moulding, whereby it e.g. becomes possible to move the first part of the moulded object (5) in the direction from the front part (1) of the mould via the middle part (3) to the back part  
30 (2) of the mould, so there is no need for ejectors before the object in its final moulded position is ready for the ejection from the mould.

8. Procedure/machine for the production of one in at least two  
35 subsequent castings moulded object as mentioned in one or more of the previous claims, characterized by the fact that the middle part (3) can be divided into several preferably vertical and similar sections (3' and 3''), which can turn around on several preferably vertical axis (4' and 4''),  
40 whereby the radius of the turning axis for each section, and consequently the for the turning necessary maximum distance between the front part (1) and the back part (2) becomes considerable less than if the middle part (3) had been undivided on a single axis with the same total surface  
45 area/width.

9. Procedure/machine for the production of one in at least two subsequent castings moulded object as mentioned in one or more of the previous claims, characterized by the fact that the  
50 mould opens in two steps preferable at first at the back part (2), whereby this part of the opening movement can be activated e.g. through a clinch-pull which can activate a core pull with e.g. a steep pitch in the front part, so that the object lies freely in the middle part (3) when the mould is

totally open. This core pull can also be driven in another way than by clinch-pull.

10. Procedure/machine characterized by the fact, that you can  
5 mould metal in one part of the machine by means of a metal  
moulding unit, and at the same time adding plastic on the  
metal in the other part of the machine in this way, e.g.  
aluminium at the front part (1) and a thermo plastic material  
at the back part (2). (This can possibly also be used/work in  
10 a normal index mould/ turn mould.)

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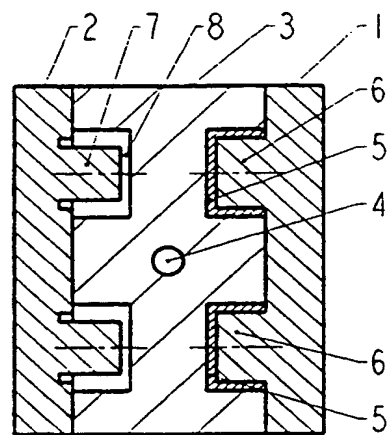


Fig. 1

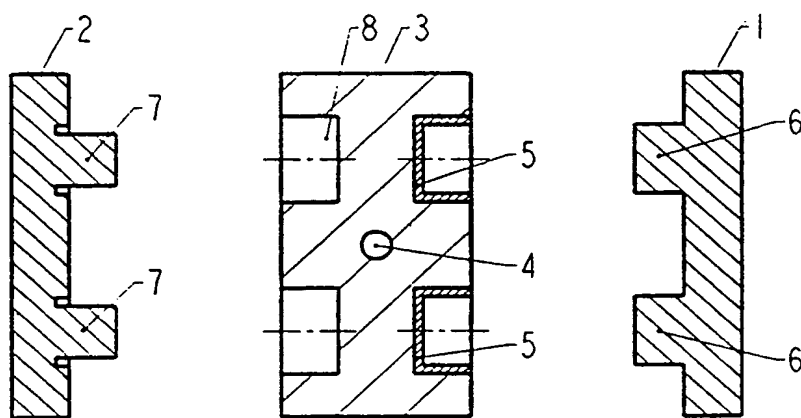


Fig. 2

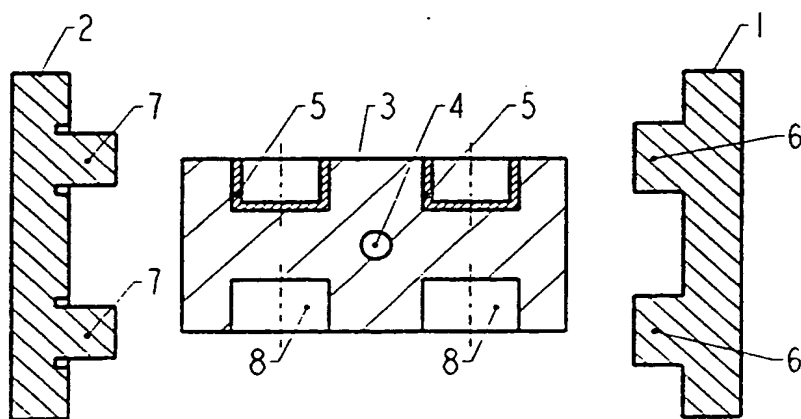


Fig. 3

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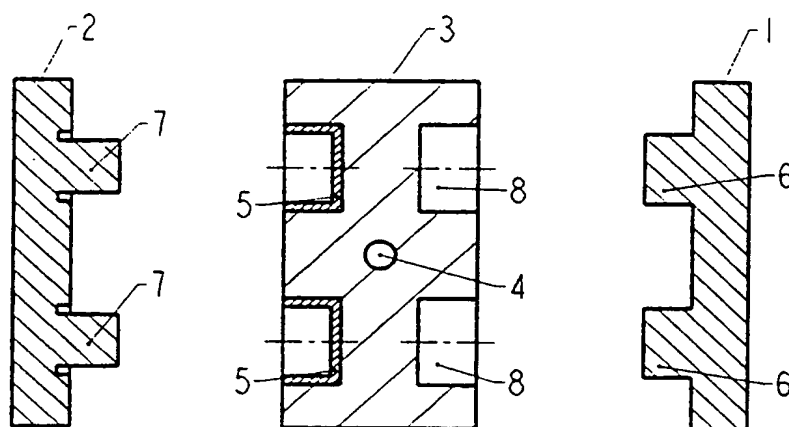


Fig. 4

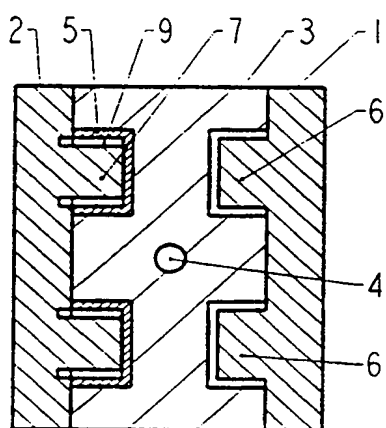


Fig. 5

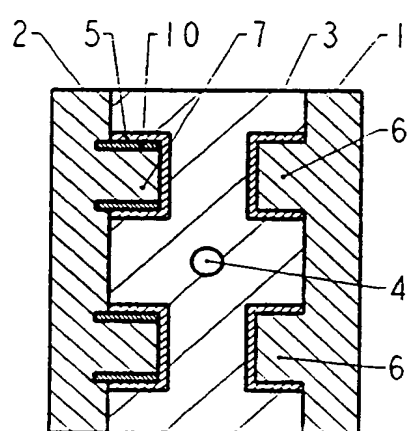


Fig. 6

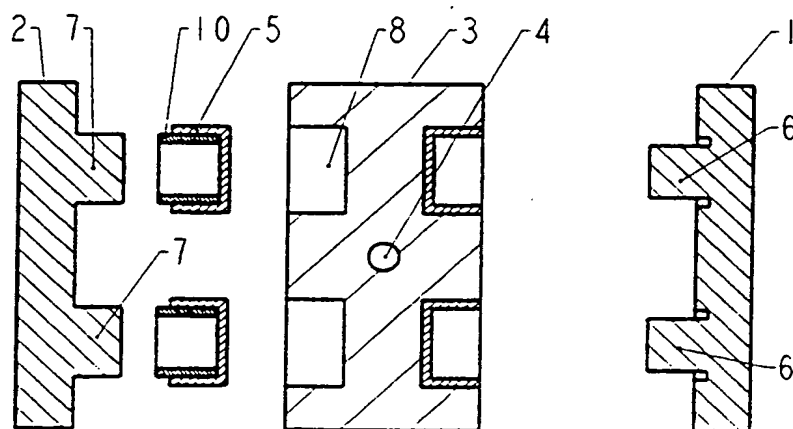


Fig. 7

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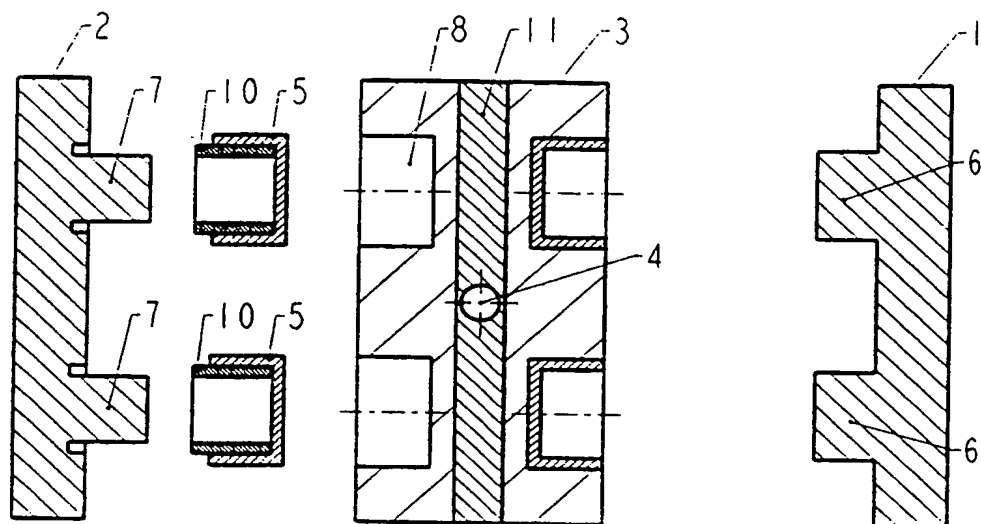


Fig. 8

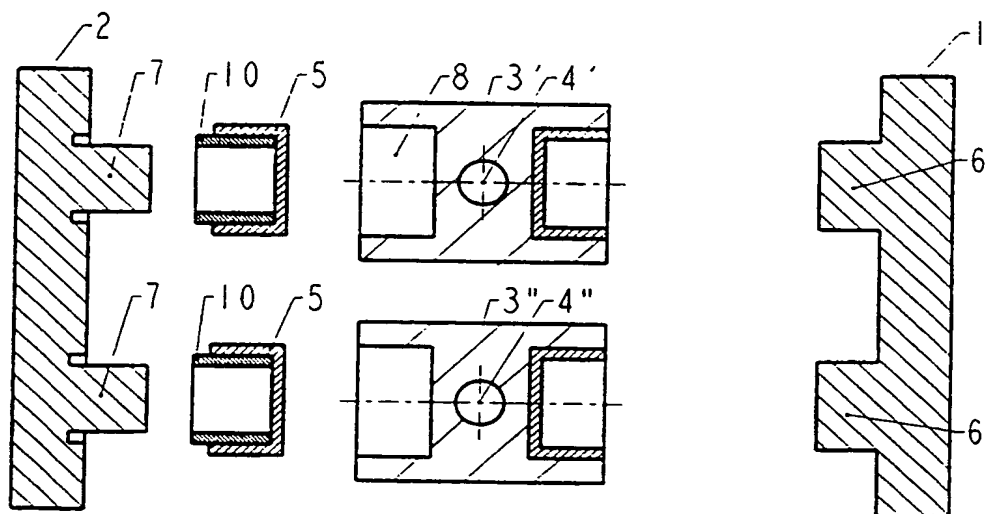


Fig. 9

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 98/00034

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B29C 45/16, B29C 45/33

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN, vol. 14, no. 384(M-1013), 20 August 1990; & JP,A,02143819 (STANLEY ELECTRIC CO LTD) 1 June 1990, see abstract, figure 1-5 --	1-2,5,7-8
X	WPI/Derwent's abstract, No 86-123123, week 8619, ABSTRACT OF JP, 61063426 (SANYO KOKUSAKU PULP CO), 1 April 1986 (01.04.86), figure 1, abstract --	10
A	DE 4032500 A1 (GELLERT, JOBST ULRICH), 16 April 1992 (16.04.92), abstract --	1-10
A	DE 4318574 A1 (BATTENFELD GMBH), 8 December 1994 (08.12.94), abstract --	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

17 June 1998

Date of mailing of the international search report

23 -06- 1998

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

09/06/98

International application No.

PCT/DK 98/00034

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